4

Creating New Instruments and Research Techniques for Discovering Cell Mechanisms

> . . . is our method of fractionation like the clumsy undertaking of a car mechanic who attempts to use his crude tools to analyze a watch? I believe that it is almost as bad as that. Nevertheless, we have no alternative and must hope that our tools will become refined as we proceed in the analysis. Meanwhile we have to look out for the signs that guide us in the right direction; we must try to correlate the experimental findings obtained with cell-free systems with the complex physiology of the cell; we must keep in view the metabolic 'Gestalt' of the cell; and finally, we must 'seek simplicity and then distrust it.'
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> (Racker, 1965, p. 89)

"Seeing is believing." So we are often told. You do not, however, have to go far to find instances in which seeing is misleading. For example, look at Figure 4.1 and ask yourself whether the shaded surfaces of the two figures are identical in shape. If you are like most people, you will judge that the shapes differ – one long and narrow, the other closer to square. However, you can convince yourself that they actually have identical dimensions if you rotate one of them 90 degrees and measure the corresponding sides. Your visual system misled you in this case about what actually exists in the world, creating what scientists refer to as an *artifact* (or *artefact*, especially in older publications). Although the term *artifact* is used in ordinary parlance for anything made by humans, in science it denotes evidence produced by instruments and experiments that does not properly reflect the phenomenon under investigation.

Although we usually regard seeing as giving us direct access to what is nearby in the world, it may be better to think of our visual system as an instrument for guiding action and producing judgments about what we are seeing. Research over the past two centuries has revealed some of the complex brain operations that enable our visual system to perform these functions